UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VIII SEMESTER

AERONAUTICAL ENGINEERING
### SCHEME -2013
#### VIII SEMESTER
#### AERONAUTICAL ENGINEERING (S)

<table>
<thead>
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<th>Name of subject</th>
<th>Credits</th>
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<td>13.801</td>
<td>Aircraft Maintenance and Repair (S)</td>
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<td>13.802</td>
<td>Aircraft Air-conditioning (S)</td>
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<td>5</td>
<td>-</td>
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**Total** | **29** | **17** | **5** | **7** | **500** | **700** | **1200** |

### 13.805 Elective IV
- 13.805.1 Project Management (S)
- 13.805.2 Reliability Engineering (S)
- 13.805.3 Aircraft Safety and Regulations (S)
- 13.805.4 Operations Research (S)
- 13.805.5 Fracture Mechanics (S)
- 13.805.6 Industrial Hydraulics (S)

### 13.806 Elective V
- 13.806.1 Aircraft Rules and Regulations (S)
- 13.806.2 Non-Destructive Testing (S)
- 13.806.3 Statistical Quality Control (S)
- 13.806.4 Industrial Pollution and Control (S)
- 13.806.5 Safety Engineering (S)
- 13.806.6 Aerodynamic Testing Facility (S)
- 13.806.7 Rockets and Missiles (S)
13.801 AIRCRAFT MAINTENANCE AND REPAIR (S)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objective:

- To enable the knowledge about the aircraft maintenance and repair practices in the aviation industry
- To impart knowledge about the aircraft tools and its operations.
- To gain more knowledge on airworthiness of an aircraft.

Module – I

MAINTENANCE SCHEDULES

Module – II

ENGINE MAINTENANCE AND REPAIR

Module – III

MAINTENANCE AND REPAIR OF AIRFRAME AND SYSTEMS

Module – IV

QUALITY AND AIRWORTHINESS ASSURANCE
Zero defect analogy – Fault tree analysis, bench marking, quality circles – TQM, Six sigma – DGCA (Directorate general of civil aviation) – FAA regulation: Licensing regulations, general regulations, and operations regulations – Aviation Safety Regulation.
References:


Internal Continuous Assessment *(Maximum Marks-50)*

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

University Examination Pattern:

*Examination duration: 3 hours*  
*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will have:

- Ability to understand tools and maintenance practices in the aviation industry.
- Ability to rectification of maintenance practices to ensure airworthiness.
13.802 AIRCRAFT AIR-CONDITIONING (S)

Teaching Scheme: 2(L) - 1(T) - 0(P)  
Credits: 3

Course Objectives:
The main objectives of this course are

- To impart the concept of the basic principles, working, scientific analysis and system components of different types of refrigeration and air conditioning systems.
- To impart the knowledge of various types of refrigerants, their properties, selection criteria and environmental aspects

Module – I
Air craft refrigeration – necessity of aircraft cooling, advantages of using air as refrigerant in air-crafts, types of air refrigeration system - 1. Simple cooling cycle system 2. Evaporative cooling system. 3. Boot strap air cycle refrigeration system 4. Regenerative cooling system. 5. Reduced ambient type cooling system. Simple numerical problems only, no derivations.

Module – II
Multi pressure systems – multi compression and multi evaporator systems – inter cooling – flash inter cooling and flash gas removal.

Module – III
Refrigerants and their properties – nomenclature of refrigerants - selection of refrigerants – environmental aspects.

Module – IV
Refrigeration system components: Compressors – general classification - working principle – comparison – advantages and disadvantages. Reciprocating compressors - single and

References

8. ASHRAE *Handbook*.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will have:

- Knowledge about the basic principle of refrigeration and air conditioning, components and their controls.
- Ability to solve problems based on the working principles.
13.803 PRINCIPLES OF MANAGEMENT (S)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

- To introduce the basics of principles of management and its need.
- To impart knowledge about the different methods and processes in management.

Module – I
Evolution of Scientific management:-Principles and functions of scientific management, Concept of pre modern, modern and post-modern management, Levels and skills of management. Organizational structure:-Authority, responsibility and span of control - system concept of management – Line, Line and staff, project and matrix organization.

Module – II
Formation of companies: Proprietary Partnership and joint stock companies – private limited, public limited companies, cooperative organizations and Government organizations. Facilities planning:-Selection of site- factors to be considered – plant layout, different types, process, product, fixed group technology layout. Layout planning, computerized planning techniques.

Module – III

Module – IV

References:


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

Students successfully completing this course will have

- Ability to solve problems on management principles.
- Knowledge about the basic structure of an organization.
13.804 SPACE TECHNOLOGY (S)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

- To introduce the fundamentals of space technology
- To impart knowledge about the orbital manoeuvres and relate to real missions.
- To enable the students to read about latest space missions and understand the crux of the same.

Module – I

INTRODUCTION TO CO ORDINATE SYSTEMS
The ecliptic and celestial equatorial planes - Reference Frames – Motion in accelerated reference plane - Euler angles and transformations- Time intervals and Epoch – International Atomic Time (TAI), Universal Time (UT), Greenwich Mean Solar Time (GMST) and Sidereal Time.

Module – II

ROCKET PROPULSION AND FUNDAMENTALS OF ORBITAL MECHANICS
Rocket propulsion fundamentals, rocket dynamics and ascent flight mechanics, chemical rockets, multi-staging and optimization, Electrical rockets. Fundamentals of orbital mechanics (two body motion, circular and escape velocity, motion in elliptic, hyperbolic and parabolic orbits).

Module – III

KEPLERIAN AND NON KEPLARIAN MOTIONS
Conics and relations, Vis-viva equation, Kepler equation, orbital elements, Orbit determination, Lambert Problem, Different Methods of solution to Lambert problem; Non-Keplerian Motion: Perturbing acceleration-Earth aspherical potential, oblateness, third body effects, atmospheric drag effects, application of perturbations.

Module – IV

FUNDAMENTALS OF ORBITAL MANEUVERS
Orbit Maneuvers: Hohmann transfer, Inclination change maneuvers, combined maneuvers, bi-elliptic maneuvers; Lunar / Interplanetary Trajectories: Concept of sphere of influence.

References:


**Internal Continuous Assessment (Maximum Marks-50)**

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

**University Examination Pattern:**

- Examination duration: 3 hours
- Maximum Total Marks: 100

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course Outcome:**

Students successfully completing this course will have

- Ability to understand terminology of state of the art space technologies
- Ability to design orbital maneuvers qualitatively.
13.805.1 PROJECT MANAGEMENT (S) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

- To deal with projects and decisions on capital investment or capital project.
- To give an exposure to the major aspects of a project.

Module – I

Planning- Capital Expenditures-Phases of capital budgeting-Levels of decision making-Facets of Project analysis- Feasibility Study-Objectives of Capital Budgeting- Resource Allocation framework-Key criteria- Elementary Investment Strategies-Portfolio Planning tools-Generation of Project ideas- Monitoring the environment- Corporate Appraisal- Scouting for project ideas-Preliminary screening- Project rating index-Sources of positive net present value.

Module – II


Module – III

Structures and civil works-Project charts and layouts-Work schedule- Financial analysis-cost of project- means of finance-Estimates of sales and production-Cost of production- working capital requirements and its financing-Profitability projections- break-even point- projected cash flow statements and balance sheets.

Project cash flows- Basic principles for measuring cash flows-Components of cash flow- cash flow illustrations- Viewing a project from different points of view-time value of money-Future value of money-single amount-Future value of an annuity-Present value of a single amount-present value of an annuity.

Module – IV

Cost of capital- cost of debt capital- Cost of preference capital-rate of return-Cost of external equity and retained earnings-Determination of weights- Appraisal criterion- Net present value-Cost benefit ratio- Internal rate of return-Urgency-payback period.

Implementation- Forms of project organization- Project planning-Project control- Human aspects of project management.- Network techniques- development of Network-Time estimation-Critical path determination-Scheduling under limited resources-PERT model-
CPM model- Network cost system-Project review- initial; review- Performance evaluation- Abandonment analysis.

References
1. Dennis Lock, Project Management, Grower Publications.
5. Amrine H. T. and John A. Ritchey, Manufacturing Organization and Management, Pearson Education.

Internal Continuous Assessment (Maximum Marks-50)
- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

University Examination Pattern:
- Examination duration: 3 hours
- Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:
- Ability to comprehend the market analysis
- Ability to manage different projects at various levels.
Course Objectives:

- To make students learn about the reliability and reliability aspects of a product.
- To implement knowledge on the importance of reliability in industries.

Module – I


Module – II


Module – III

System Reliability, Reliability improvement, Reliability allocation, cost aspects in reliability, Availability and maintainability.

Module – IV

Case studies from industries demonstrating Reliability aspects. Computer aspects in Reliability and Reliability engineering.

References


Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

- Ability to comprehend the reliability aspects of different products.
- Ability to solve problems based on different methods in reliability.
13.805.3 AIRCRAFT SAFETY AND REGULATIONS (S) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P)  Credits: 4

Course Objectives:

To impart knowledge about the civil air rules and regulations which are being followed by Directorate General of Civil Aviation.

Module – I

C.A.R. SERIES ‘A’: Procedure for civil air worthiness requirements and responsibility operators vis-à-vis air worthiness directorate – Responsibilities of operators / owners- Procedure of CAR issue – amendments etc.– Objectives and targets of airworthiness directorate – Airworthiness regulations and safety oversight of engineering activities of operators.

Module – II


Module – III

C.A.R. SERIES ‘E’: Approval of organizations in categories A, B, C, D, E, F, G - Requirements of infrastructure at stations other than parent base.

Module – IV

C.A.R. SERIES ‘T’ & ‘X’: Flight testing of (Series) aircraft for issue of C of A – Flight testing of aircraft for which C of A had been previously issued – Registration Markings of aircraft –
Weight and balance control of an aircraft – Provision of first aid kits & Physician’s kit in an aircraft – Use furnishing materials in an aircraft – Concessions – Aircraft log books – Document to be carried on board on Indian registered aircraft – Procedure for issue of tax permit – Procedure for issue of type approval of aircraft components and equipment including instruments.

References


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

**University Examination Pattern:**

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course outcome:**

- Knowledge on the civil air rules and regulations which are being followed by Directorate General of Civil Aviation.
13.805.4 OPERATIONS RESEARCH (S) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:
To introduce basic concepts of LPP, Sequencing, game theory, inventory etc.

Module – I
Development – definition– characteristics and phases – types of models – operation research models – applications.


Module – II
Replacement: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.


Module – III

Inventory: Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost.

Module – IV

References


Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

*Examination duration: 3 hours*  
*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

*Ability to comprehend the application of LPP, Game Theory, Inventory, Simulation etc.*
13.805.5 FRACTURE MECHANICS (S) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objectives:

- To understand the importance of fracture mechanics in aerospace applications.
- To be able to predict the fracture life of a component.
- To be able to model the fracture mechanisms.

Module – I

Linear elastic fracture mechanics (LEFM): Elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width.

Module – II

Superposition of stress intensity factors (SIF) – SIF solutions for well-known problems such as centre cracked plate, single edge notched plate, and embedded elliptical cracks Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour  

Module – III

Elastic plastic fracture mechanics (EPFM): Development of EPFM - J-integral – crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard JIC test and COD test  

Module – IV

Sustained load fracture: Time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of sustained load fracture testing
Practical problems: Through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures.

References

Internal Continuous Assessment (Maximum Marks-50)
50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:
Examination duration: 3 hours Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:
- Prediction the fracture life of an aerospace component.
- Development of a thorough understanding of fracture mechanisms
13.805.6 INDUSTRIAL HYDRAULICS (S) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P)  Credits: 4

Course Objectives:

- To have a basic understanding of hydraulic components and circuits
- To be able to read and interpret industrial hydraulic circuits

Module – I


Module – II


Module – III

Fluid temperature control – Fluid pressure control – control valves – Sequence valve – Counterbalance valve-unloading valve – Friction control valve – Servo systems.

Module – IV

Industrial hydraulic circuits - Circuit design for – shaper, grinder, material handling equipments, processes - Miscellaneous circuits.

References


Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

- Thorough understanding of symbols and characters in a hydraulic circuits
- Ability to design a hydraulic circuit in the view point of a new need.
13.806.1 AIRCRAFT RULES AND REGULATIONS (S) (Elective V)

Teaching Scheme: 3(L) - 0(T) - 0(P)  
Credits: 3

Course Objectives:
To impart knowledge about the civil air rules and regulations which are being followed by Directorate General of Civil Aviation.

Module – I

GENERAL CONDITIONS OF FLYING
Use and operation of aircraft – Registration and nationality and registration marks – Prohibited flight – Licensing of personnel – Type of aircraft to be included in rating – Flights to qualify for extension of a licence – Flights for testing and other non-revenue specific special purposes. – Documents to be carried in aircraft – Carriage of cock-pit check list in aircraft.

Module – II

GENERAL SAFETY CONDITIONS
Dangerous flying – Assault and other acts of interference against a crew member – Assault and other acts endangering safety or jeopardizing good order and discipline – Prohibition of intoxicated persons entering aircraft – Carriage of persons suffering from mental disorders or epilepsy in aircraft – Carriage of prisoners in aircraft – Carriage of animals, birds and reptiles in aircraft – Smoking in aircraft – Fuelling of aircraft, Housing of aircraft – Dropping of articles and descents by parachutes – Carriage of persons in unauthorized part of aircraft – Minimum age for sole control of aircraft – Maximum age limit for professional pilots – Acts likely to imperil safety of aircraft – Prohibition of operating civil aircraft causing sonic boom – Prohibition on the use of portable electronic devices – Adoption of the Convention and Annexes – Safety Management Systems.

Module – III

REGISTRATION AND MARKING OF AIRCRAFT
Certificate of registration – Nature of application – Aircraft imported by air – Change in ownership – Aircraft destroyed or withdrawn from use – Registration fees – Register of aircraft – Nationality and Registration marks, how to be affixed – Use of State marks.

Module – IV

PERSONNEL OF AIRCRAFT
Licensing authority – Carriage of operating crew – Carriage of a cabin crew – Disqualification from holding or obtaining a license – Medical standards – Period of validity of medical fitness and Licenses – Proof of competency – Checks, test and examinations – Approved Training Organization – Licenses and their renewal – Pilot not to fly for more than 125 hours during any period of 30 consecutive days – Aircraft not registered in India – Validation of
foreign licenses – Minimum age for holding a license – Minimum educational qualification for holding a license – Fees and other charges.

References


Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able to understand the civil air rules and regulations which are being followed by Directorate General of Civil Aviation.
13.806.2 NON DESTRUCTIVE TESTING (S) (Elective V)

**Teaching Scheme:** 3(L) - 0(T) - 0(P)  
**Credits:** 3

**Course Objectives:**
- To impart knowledge in various methods of Non Destructive Testing.
- To appreciate the importance of NDT in Aerospace engineering.

**Module – I**


**Module – II**


**Module – III**


**Module – IV**


Introduction, Principle of operation Type of Ultrasonic Propagation- Ultrasonic probes, Types of Transducers - Ultrasonic Testing Techniques. Method for Evaluating Discontinuities-Ultrasonic Testing Procedures for different component - applications, advantages and
limitations, Documentation, Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements.

References

3. www.ndt-ed.org

Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

- Ability to suggest mode of NDT tests for different materials
- Ability to interpret different acceptance standards.
13.806.3 STATISTICAL QUALITY CONTROL (S) (Elective V)

Teaching Scheme: 3(L) - 0(T) - 0(P)  
Credits: 3

Course Objectives:
- To have an understanding of the basics of quality control
- To be able to use modern tools in statistical quality control.
- To develop a scientific base for reliability.

Module – I
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process - factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and s chart.

Module – II
Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.  
The concept of Acceptance sampling, Economics of inspections, Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – The Operating characteristic curve– producer’s Risk and consumer’s Risk.

Module – III
AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans. Minimum inspection per lot, Formulation of Inspection lots and selection of samples.  
Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems.

Module – IV

References

**Internal Continuous Assessment** *(Maximum Marks-50)*

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours*                *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A** (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B** (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course outcome:**

*At the end of this course the students will be able to*

- Apply quality principle to real life problems.
- Visualize and interpret data in quality perspective.
- Use control charts efficiently.
13.806.4 INDUSTRIAL POLLUTION AND CONTROL (S) (Elective V)

Teaching Scheme: 3(L) - 0(T) - 0(P)  
Credits: 3

Course Objectives:

- To imbibe the idea of pollution control and how it can be achieved.
- To understand the standards for emission control
- To develop the foundation for sustainable industrial ecology.

Module – I

Environmental aspects - Impact of environment - Environmental quality – Role of environmental engineer. Air quantity - Definition, Characteristics and prospective - Types of our air pollutants - effect of air pollution on men and environment - Formation of air pollutants from combustion of fossil fuels and parameters controlling the formation.

Module – II

Water pollution from tanneries and other industries - Engineered systems for waste water treatment and disposal - Control systems and instrumentation for pollution control.

Module – III

Definition, characteristics - Types and sources of solid waste - Solid waste management - generation, collection, storage and processing techniques - Solid waste disposal.

Module – IV

Methods and equipment’s for industrial waste treatment - Pollution thermal power plants and nuclear power plants - Sources and control methods - Emission from SI and CI engines - Evaporative emission control –Exhaust treatment devices - Noise pollution and their control.

References


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

**University Examination Pattern:**

Examination duration: 3 hours  
Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course outcome:**

- Ability to distinguish between sources of pollution and their impacts.
- Ability to device new control methods aimed at reducing pollution.
Course Objectives:

- To develop an understanding of the safety regulations for different scenarios
- To understand the importance of safety in engineering
- To imbibe safety as a prime factor to be monitored in an industry.

Module – I


Module – II


Module – III


Module – IV

References


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course outcome:**

At the end of this course the students will be able to

- Read and understand different safety regulations
- Suggest new amendments to safety regulations in the existing world.
13.806.6 AERODYNAMIC TESTING FACILITY (S) (Elective V)

Teaching Scheme: 3(L) - 0(T) - 0(P)  
Credits: 3

Course Objectives:

To present the measurement techniques involved in aerodynamic testing.

Module – I
Low speed wind tunnels-estimation of energy ratio and power required supersonic wind tunnels-calculation of running time and storage tank requirements. Estimation of flow angularity and turbulence factor-calculation of CL and CD on aero foils from pressure distribution- CD from wake survey-Test section average velocity using traversing rakes-span wise load distribution for different taper ratios of wing.

Module – II
Mach number estimation in test section by pressure measurement and using a wedge – preliminary estimates of blowing and running pressures, nozzle area ratios, and mass flow for a given test section size and Mach number-starting problem and starting loads.

Module – III
Hot wire anemometer and laser Doppler anemometer for turbulence and velocity measurements-Use of thermocouples and pyrometers for measurement of static and total temperatures-Use of pressure transducers, Rota meters and ultrasonic flow meters.

Module – IV

References

Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  
Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

Ability to perform various measurement involved in aerodynamic testing.
13.806.7 ROCKETS AND MISSILES (S) (Elective V)

Teaching Scheme: 3(L) - 0(T) - 0(P)  
Credits: 3

Course Objectives:

- To introduce basic concepts of design of rockets and missiles.
- To estimate the trajectory of rockets and missiles.

Module – I

ROCKETS SYSTEM
Ignition system in rockets- types of igniters- Igniter design considerations-Design consideration of Liquid rocket combustion chamber, injector propellant feed lines, Valves, Propellant Tanks Outlet and Helium pressurized and turbine feed systems, Propellant Slash and Propellant Hammer-Elimination of Geysering effect in missiles- Combustion system of solid rockets.

Module – II

AERODYNAMICS OF ROCKETS AND MISSILES
Airframe components of rockets and missiles- Forces acting on a missile while passing through atmosphere-Classification of missiles- Methods of describing aerodynamic forces and moments-Latera Aerodynamic moment-Lateral Damping moment and Longitudinal moment of a rocket- Lift and Drag forces- Drag estimation-Body Up wash and Downwash in missiles-Rocket Dispersion numerical problems.

Module – III

ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD
One dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields- Description of vertical, inclined and gravity turn trajectories-Determination of range and altitude- Simple approximations to Burnout velocities.

Module – IV

STAGING OF ROCKETS
Staging and control of rockets and missiles- Rocket Vector Control Methods- Thrust determination-SITVC- Multistaging of rockets-Vehicle Optimization-Stage Separation Dynamics- Separation Techniques. Selection of materials- Special requirements of materials to perform under adverse conditions.

References


**Internal Continuous Assessment (Maximum Marks-50)**

- 50% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
- 20% - Regularity in the class

**University Examination Pattern:**

- Examination duration: 3 hours
- Maximum Total Marks: 100

The question paper shall consist of 2 parts.

**Part A (20 marks)** - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

**Part B (80 Marks)** - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

**Course outcome:**

- Ability to comprehend the aerodynamics of rockets and missiles in all conditions.
- Ability to comprehend the various components of rockets and missiles.
13.807 SEMINAR (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 2(P)  
Credits: 2

Course Objective:

*The main objective of this course is to provide experience in presentations and to improve their communication skills.*

The student shall present a seminar on a topic which is of high relevance to Mechanical Engineering. A seminar report must be submitted at the end of the semester. The topic of the seminar shall be different from the topic of his/her project work which is being done during seventh and eighth semesters.

Internal Continuous Assessment *(Maximum Marks-100)*

40% - Assessment by the Guide
40% - Assessment by the Committee.
20% - Regularity in the class

Course Outcome:

*After completion of this course the students will be able to*

- *Acquire the basic skills to perform literature survey and present papers*
- *Acquire communication skills*
13.808 PROJECT, VIVA-VOCE AND INDUSTRIAL VISIT (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 5(P)  
Credits: 5

Course Objective:
- To do a detailed study on a selected topic based on current journals or published papers.
- To impart the ability to perform as an individual as well as a team member in completing a project work.

The project work (project phase 1) started in the seventh semester, shall be continued (project phase 2) in the eight semester. The student/s must submit the final project report at the end of the eight semester. At least two evaluations should be conducted by a panel consisting of project coordinator/senior faculty, project guide, and a faculty specialized in the area. The students may be assessed individually and in groups.

Internal Continuous Assessment (Maximum Marks-100)

The distribution of marks is as follows:

Work Assessed by Guide: 50%
Assessed by a three member committee: 50%

University Examination Pattern:

Viva-Voce  
Maximum Total Marks: 100
Marks shall be awarded based on the overall performance, Project report, Seminar report, Subject knowledge and general awareness in the field of Mechanical Engineering

Course Outcome:

After completion of this course the students will be able to

- Acquire the basic skills to perform literature survey and present papers
- Acquire communication skills and improve their leadership quality as well as the ability to work in groups.